April 10, 2018

FILED ELECTRONICALLY VIA ECFS

Jose Albuquerque
Chief, Satellite Division
International Bureau
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: *Ex Parte* filing, IB Docket No. 16-408

Dear Mr. Albuquerque:

Telesat Canada ("Telesat") and WorldVu Satellites Limited, d/b/a OneWeb ("OneWeb") recently explained to each of the Commissioners' offices and to staff from the Commission's International Bureau[1] that the Δ T/T proposal OneWeb made in the above-referenced proceeding was intended only as a means of determining—based on an overall system assessment—when NGSO operators were required to coordinate their systems. The companies distinguished this from the rule adopted by the Commission under which, absent coordination, band splitting would be applied during in-line events—based on detailed, real-time operating parameters—whenever and wherever the ΔT/T of an interfered link exceeds six percent.

In this filing, Telesat and OneWeb address this matter in additional detail.

A major goal in this proceeding has been to find a mechanism that operators can use to determine the potential for inter-system interference, particularly during in-line events. The Commission initially proposed a fixed separation angle to determine when there will be interference among NGSO FSS systems, in which case frequencies would have to be divided or shared. In response, Telesat demonstrated that no single separation angle could be established and OneWeb proposed the ΔT/T calculation as a

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1 *See e.g.,* Letter from Henry Goldberg, counsel for Telesat, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 16-408 (March 19, 2018) (summarizing a meeting with Rachael Bender, Wireless and International Advisor to Chairman Ajit Pai).

coordination trigger. The Commission accepted Telesat's analysis and a portion of OneWeb's proposal, as reflected in the *Report and Order*.[2]

Unfortunately, the Commission adopted the ΔT/T calculation for managing real-time coordination, rather than just as a coordination trigger. ΔT/T cannot be used for real-time coordination because there is no way for the operators to know the required information in advance, as information that is necessary to make a ΔT/T calculation is constantly changing. The attached analysis demonstrates that, in order to determine when a system will experience an exceedance of a predetermined ΔT/T due to interference from another system, operators need to know in real-time and for each of the systems implemented with common frequency and polarization the following:

- Satellite ephemeris data;
- Satellite beam pointing, antenna pattern, transmit EIRP, receive gain and inherent noise temperature; and
- The earth station location, antenna pattern, transmit EIRP, receive gain and inherent noise temperature.

With the exception of the satellite ephemeris data, which has been agreed to be shared, the relevant system parameters will change constantly to meet customer requirements and operational conditions. NGSO satellites may implement steerable/swept/hopping/staring beams and may adapt beam shape, pointing, bandwidth and power in real time to accommodate changes in demand.

The dynamic nature of service provided by an NGSO system will lead to adjustments that react to changes in customer requirements and system operations. Events such as congestion, heavy rain fade at a site, changes in user demand, etc. will all require changing the satellite/beam selection for a given service area. In addition, users will be added or removed. Further, the time in which such changes need to be made is measured in milliseconds. There is simply no way that operators can exchange information on changes fast enough to allow the operators to determine if those changes will result in an in-line event and to take corrective action. This is distinct from what occurs during a coordination based on ITU procedures, in which adjustments can be agreed to that are not dependent on having detailed operational information in real time.

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[2] *See Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, IB- Docket No. 16-408, FCC 17-122, at ¶ 49 (rel. Sept 27, 2017) ("*Report and Order*").

Furthermore, the adoption of a band splitting rule that cannot be implemented results in harmful uncertainty with respect to spectrum access. Because it is impossible to determine instances where and when sharing would definitively be required, the rule creates an unknown and unpredictable operating environment creating risk, uncertainty, and the potential for chilling investment in NGSO systems.

It is true that the Commission's spectrum sharing rule applies only in the United States and not in the rest of the world.[3] However, the uncertainties created by users receiving satellite services on the border, for example, between Canada and the United States raise yet another set of variables that highlight the impossibility of utilizing the $\Delta T/T$ threshold in real time. Telesat and OneWeb could literally have millions of users living on or near the border between Canada and the United States, and in many cases a satellite beam will cover territory on both sides of the border. Mobile users, a major use case, will add another level of complexity. These are not just theoretical issues; they are practical problems that will need to be solved for operators to provide interference-free service. The Commission's rule as adopted does not allow for a solution to these problems.

In addition, the data required to calculate $\Delta T/T$, even if determinable in real time, would be commercially and customer-sensitive. It would identify the location of customers, which could include, for example, locations of government operations, including the location of a military unit using the system. For military or other users requiring confidentiality, a requirement to provide such information could prevent their use of NGSO systems entirely. In addition, it would provide competitors insight into the location of customers allowing them to target those customers or target other areas, in either case, advancing their competitive position *vis-à-vis* the company providing such information. ViaSat has summarized the issue as follows:

> "As an initial matter, real-time pointing data of this type is highly sensitive and competitive business information. A requirement to provide such data would provide competitors with insight into the location of ViaSat's

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3 *See e.g., Space Exploration Holdings, LLC Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System and System Supplement*, Memorandum Opinion, Order and Authorization, FCC 18-38 at para. 8 (rel. Mar 29, 2018) ("However, we note that outside the United States (i.e., when communications to or from the U.S. territory are not involved) the coexistence between SpaceX's operations and operations of a system that received a grant for access to the U.S. market are governed only by the ITU Radio Regulations as well as the regulations of the country where the earth station is located and not subject to 25.261 [i.e., the band splitting rule]).").

> customers and areas being targeted under ViaSat's business plans. Competitors could use this information to either target those areas (harming ViaSat's competitive position) or target other areas (undermining competition)."[4]

For all these reasons, exchanging and acting on calculations in real time based on a ΔT/T standard is unworkable. Obviously, the Commission should not adopt a rule that cannot be implemented in the real world and that could chill investment in new systems due to spectrum uncertainty. Rather than adopt an unworkable rule, the Commission should require FCC-authorized operators to coordinate their systems by following the well-known and well-established ITU procedures.

Please direct any questions regarding this matter to the undersigned and to Brian Weimer of Sheppard, Mullin, Richter & Hampton LLP, counsel for OneWeb.

Respectfully submitted,

Henry Goldberg
Attorney for Telesat Canada

cc: Rachael Bender, Wireless & International Advisor to Chairman Ajit Pai
Erin McGrath, Legal Advisor, Wireless, Public Safety & International to Commissioner O'Rielly
Louis Peraertz, Senior Legal Advisor, Wireless, International, and Public Safety to Commissioner Clyburn
Umair Javed, Legal Advisor, Wireless and International to Commissioner Rosenworcel
Kate Black, Policy Advisor to Commissioner Rosenworcel
Will Adams, Legal Advisor to Commissioner Carr

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[4] Consolidated Response of ViaSat, IBFS File No. SAT-PDR-20161115-00120, at 4 (filed August 1, 2017) (footnote omitted).

White Paper on Delta T / T (ΔT/T)

ΔT/T is a calculation that shows the increase in (undesirable) noise of a wanted system due to the transmissions of an Interfering system. ΔT/T can be calculated in the uplink direction, i.e. at the wanted satellite, or in the downlink direction, i.e. at the wanted earth station.

Downlink ΔT/T calculation

Figure 1 illustrates a ΔT/T calculation in the *downlink* direction. The Wanted Earth Station is intending to receive a signal from its Wanted Satellite but is also receiving transmissions spilling from an Interfering Satellite intending to communicate with its own earth station. Table 1 indicates the data elements that would be required to make the ΔT/T calculation, with an indication of the practicality of exchanging such information for real time calculations.

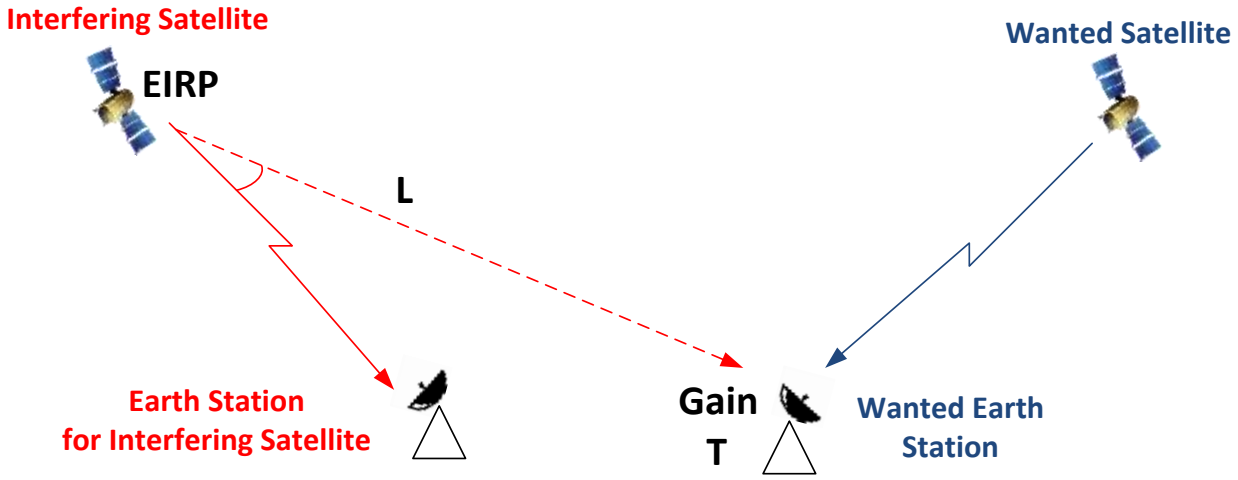

Figure 1: Illustration of ΔT/T calculation in the downlink direction, i.e. interference at the Wanted Earth Station

$$\frac{\Delta T}{T} = \frac{1}{k\,T}\left[\frac{EIRP_{interfering\ satellite} \cdot Gain_{wanted\ earth\ station}}{L}\right]$$

where: k = Boltzmann Constant

White Paper on Delta T / T (ΔT/T)

To calculate the ΔT/T at the Wanted Earth Station the information provided in Table 1 is required.

Table 1: Data items required for a ΔT/T calculation at the Wanted Earth Station

			DATA ITEM REQUIRED	PRACTICAL TO EXCHANGE IN REAL TIME?
1	T	Wanted Earth Station's Noise Temperature	a) Inherent Noise Temperature of the Wanted Earth Station	No
2	EIRP	EIRP of the Interfering Satellite in the direction of the Wanted Earth Station	a) Interfering Satellite ephemeris	Yes
			b) Interfering Satellite power	No
			c) Interfering Satellite antenna pattern	No
			d) Interfering Satellite pointing	No
3	Gain	Gain of the Wanted Earth Station in the direction of the Interfering Satellite	a) Wanted Satellite ephemeris	Yes
			b) Wanted Earth Station antenna pattern	No
			c) Wanted Earth Station pointing	No
4	L	Distance between the Interfering Satellite and the Wanted Earth Station	a) Interfering Satellite ephemeris	Yes
			b) Location of the Wanted Earth Station	No

Uplink ΔT/T calculation

Figure 2 illustrates a ΔT/T calculation in the *uplink* direction. The Wanted Satellite is intending to receive a signal from its Wanted Earth Station but is also receiving transmissions spilling from an Interfering Earth Station intending to communicate with its own satellite. Table 2 indicates the data elements that would be required to make the ΔT/T calculation, with an indication of the practicality of exchanging such information for real time calculations.

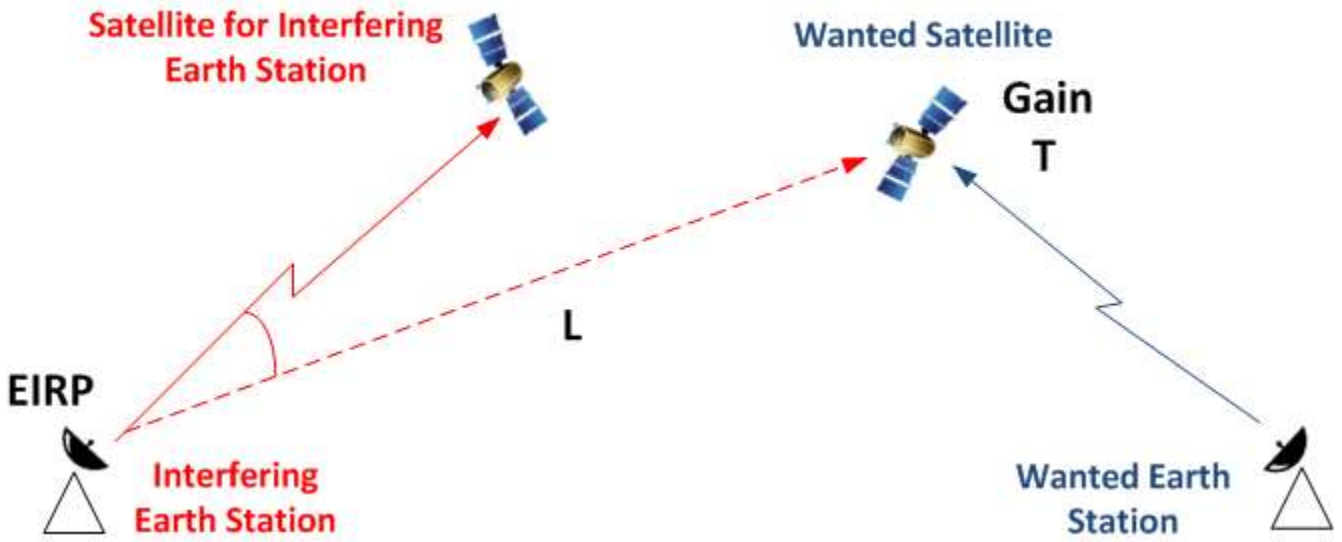

Figure 2: Illustration of ΔT/T calculation in the uplink direction, i.e. interference at the Wanted Satellite

$$\frac{\Delta T}{T} = \frac{1}{k\,T}\left[\frac{EIRP_{interfering\ earth\ station} \cdot Gain_{wanted\ satellite}}{L}\right]$$

where: k = Boltzmann Constant

To calculate the ΔT/T at the Wanted Satellite the information provided in Table 2 is required.

Table 2: Data items required for ΔT/T calculation at the Wanted Satellite

			DATA ITEM REQUIRED	PRACTICAL TO EXCHANGE IN REAL TIME?
1	T	Wanted Satellite's Noise Temperature	b) Inherent Noise Temperature of the Wanted Satellite	No
2	EIRP	EIRP of the Interfering Earth Station in the direction of the Wanted Satellite	e) Interfering Satellite ephemeris	Yes
			f) Interfering Earth Station power	No
			g) Interfering Earth Station antenna pattern	No
			h) Interfering Earth Station pointing	No
3	Gain	Gain of the Wanted Satellite in the direction of the Interfering Earth Station	d) Wanted Satellite ephemeris	Yes
			e) Wanted Satellite antenna pattern	No
			f) Wanted Satellite pointing	No
4	L	Distance between the Interfering Earth Station and the Wanted Satellite	c) Wanted Satellite ephemeris	Yes
			d) Location of the Interfering Earth Station	No